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**331. Proposed by T. H. GRONWALL, Chicago, Illinois.**

To show that:

- (1)  $\frac{d^n}{dx^n} \left( \frac{\sin x}{x} \right) = \frac{1}{x^{n+1}} \int_0^x y^n \sin \left( y + \frac{n+1}{2} \pi \right) dy,$   
 (2)  $\frac{d^n}{dx^n} \left( \frac{1 - \cos x}{x} \right) = \frac{1}{x^{n+1}} \int_0^x y^n \sin \left( y + \frac{n}{2} \pi \right) dy.$

SOLUTION BY ELIJAH SWIFT, Princeton, N. J.

Assume that the formula is true for  $n - 1$ .

Then

$$\frac{d^{n-1}}{dx^{n-1}} \left( \frac{\sin x}{x} \right) = \frac{1}{x^n} \int_0^x y^{n-1} \sin \left( y + \frac{n}{2} \pi \right) dy.$$

Differentiating both sides and using the formula we have to prove

$$(A) \quad \frac{1}{x^{n+1}} \int_0^x y^n \sin \left( y + \frac{n+1}{2} \pi \right) dy = -\frac{n}{x^{n+1}} \int_0^x y^{n-1} \sin \left( y + \frac{n}{2} \pi \right) dy \\ + \frac{1}{x^n} \cdot x^{n-1} \sin \left( x + \frac{n}{2} \pi \right).$$

or

$$(B) \quad \int_0^x y^n \sin \left( y + \frac{n+1}{2} \pi \right) dy = -n \int_0^x y^{n-1} \sin \left( y + \frac{n\pi}{2} \right) dy \\ + x^n \sin \left( x + \frac{n}{2} \pi \right).$$

Differentiating  $B$  as to  $x$ ,

$$(C) \quad x^n \sin \left( x + \frac{n+1}{2} \pi \right) = -nx^{n-1} \sin \left( x + \frac{n\pi}{2} \right) + nx^{n-1} \sin \left( x + \frac{n\pi}{2} \right) \\ + x^n \cos \left( x + \frac{n\pi}{2} \right).$$

which is obviously an identity.

Hence  $(B)$  is an identity, except for an additive constant. This constant must be zero, as we see if we let  $x$  approach zero.  $(A)$  follows from  $(B)$ . Then since the given formula holds for  $n = 0$ , it holds for all values of  $n$ .

Formula (2) may be derived in the same manner.

Also solved by A. M. Harding, W. C. Eells and the Proposer.

## NEWS AND NOTES.

FLORIAN CAJORI, CHAIRMAN OF THE COMMITTEE.

The March number of *Popular Science Monthly* contains an article on "Henri Poincaré as an Investigator" by PROFESSOR JAMES B. SHAW.

PROFESSOR G. A. MILLER, of the University of Illinois, will teach in the summer session of the University of California.

A campaign is in progress to raise a fund of about \$100,000 for the purpose of endowing a second professorship of natural philosophy at the University of Edinburgh, as a memorial to PROFESSOR PETER GUTHRIE TAIT who died in 1901, after a long career as professor at Edinburgh. To mathematicians Tait is best known for his book on quaternions and his topological researches on knots.

PROFESSOR CONSTANTIN CARATHÉODORY has been appointed professor of mathematics at the University of Göttingen as successor to Professor Felix Klein. Carathéodory made his doctorate at Göttingen in 1904, was privatdozent at Göttingen and Bonn, then professor at Hanover and Breslau.

PROFESSOR VIVANTI, University of Pavia, Italy, has recently published a volume of about 500 pages, entitled "*Esercizi di analisi infinitesimale.*" The book is composed of 575 problems and their solutions. The problems are chosen especially with a view to applications in mechanics and in physics, and more than two-thirds of them are said to be new. A large number of these exercises relate to finding the derivative or the integral. The work closes with solutions of differential equations and a few problems in the calculus of variations. The arrangement of the material is similar to that of the "*Lezioni di analisi infinitesimale,*" which was published by the same author in 1911.

The following suggestion from a new subscriber, whose attention was arrested by the Foreword in the January issue, may contain some pedagogical significance: ". . . In short why not get contributions from those who do not like mathematics, telling just what it was about their college course in mathematics which was distasteful to them. This might include not only college students at the present time in advanced classes, but also men and women who have excelled in other lines but did not prefer mathematics. Such contributions, of course, would be of little interest to mathematicians, but they would no doubt bring to light some matters very useful to those concerned with the teaching of mathematics. I am one who believes the popular distaste for mathematics is brought about largely by poor teaching methods, and that in the large majority of cases the students' dislike may be traced to instructors' methods rather than to anything in the mathematics itself." A really scientific investigation along this line might lead to valuable results.

See also the leading article in this issue, entitled "Some things we wish to know."

Attention is called to the advertisements of publishers and others in the various issues of the MONTHLY. The EDITORS desire to express their appreciation of the interest shown by the representatives of these firms in thus contributing toward the support of this journal. We trust that our readers will reciprocate this interest by referring to these announcements whenever possible.

#### SUMMER COURSES IN MATHEMATICS FOR 1913.

UNIVERSITY OF CHICAGO. June 16 to August 29. See the February issue.

UNIVERSITY OF ILLINOIS. June 16 to August 8.—By Dr. Crathorne, College

algebra (6 hours), Calculus of variations (6 hours); By Dr. Börger, Trigonometry (5 hours), Theory of equations (6 hours); By Mr. Rutledge, Analytic geometry (10 hours); By Mr. Rowland, First course in calculus (10 hours); By Mr. Carscallen, Second course in calculus (6 hours). These courses are equivalent in credit and in number of class room hours to the corresponding courses given in the regular university year.

UNIVERSITY OF KANSAS. June 12 to July 23.—By Assistant Professor Duval, Solid geometry (2 hours), Higher algebra II (3 hours, graduate credit); By Associate Professor Van der Vries, Plane trigonometry (2 hours), Projective geometry (2 hours, graduate credit); By Assistant Professor Jordan, Analytic geometry I (2 hours), Calculus I (3 hours). It is planned to offer a series of six different graduate courses in three consecutive summer sessions, giving a total of 15 hours credit toward the A.M. degree.

UNIVERSITY OF MICHIGAN. June 21 to August 22.—By Professor W. W. Beman, Differential equations, Geometry and algebra (Teachers' Course); By Professor J. L. Markley, Theory of functions, Differential calculus; By Professor W. B. Ford; Infinite series and products, Harmonic analysis; By Professor P. Field; Projective geometry, College algebra; By Professor T. R. Running, Differential and integral calculus; By Professor L. C. Karpinski, History of mathematics (arithmetic and algebra), Analytic geometry (double course); By Mr. Escott, Theory of finance, insurance and statistics, Trigonometry; By Mr. Garretson, Solid geometry, Solid analytic geometry; By Mr. Coe, Elementary algebra, Plane geometry; By Mr. Hopkins, Calculus.

UNIVERSITY OF MINNESOTA.—By Dean J. F. Downey, Higher algebra, part I, Higher algebra, part II; By Professor W. E. Brooke, Trigonometry and analytic geometry, Differential and integral calculus; By Professor W. H. Kirchner, Solid geometry, Descriptive geometry; By Dr. H. L. Slobin, Trigonometry, Analytic geometry.

UNIVERSITY OF WISCONSIN. June 23 to August 1.—By Professor Van Vleck, College algebra, Axioms of geometry, Principal functions of mathematics and physics; By Assistant Professor Hart, Elementary solid geometry, Analytic geometry, The teaching of secondary mathematics; By Assistant Professor Dowling, Plane trigonometry and logarithms, Calculus, Introduction to higher plane curves; By Assistant Professor Dresden, Theory of complex numbers and algebraic equations, Differential equations, Calculus of variations; By Mr. Burgess, Elementary analysis (begins June 16), Elementary theory of transformations; By Mr. Taylor, Integral calculus (begins June 19).

THE UNIVERSITY OF CALIFORNIA.—By Assistant Professor J. H. McDonald, Solid geometry, Theory of functions of a complex variable; By Associate Professor D. N. Lehmer, Plane analytic geometry, Differential calculus; By Professor G. A. Miller, Plane trigonometry, Theory of algebraic equations; By Mr. B. A. Bernstein, Graphic algebra, Integral calculus; By Miss Thirmuthis Brookman, Mathematical teaching in the high school, Teachers' course in mathematics for secondary schools.